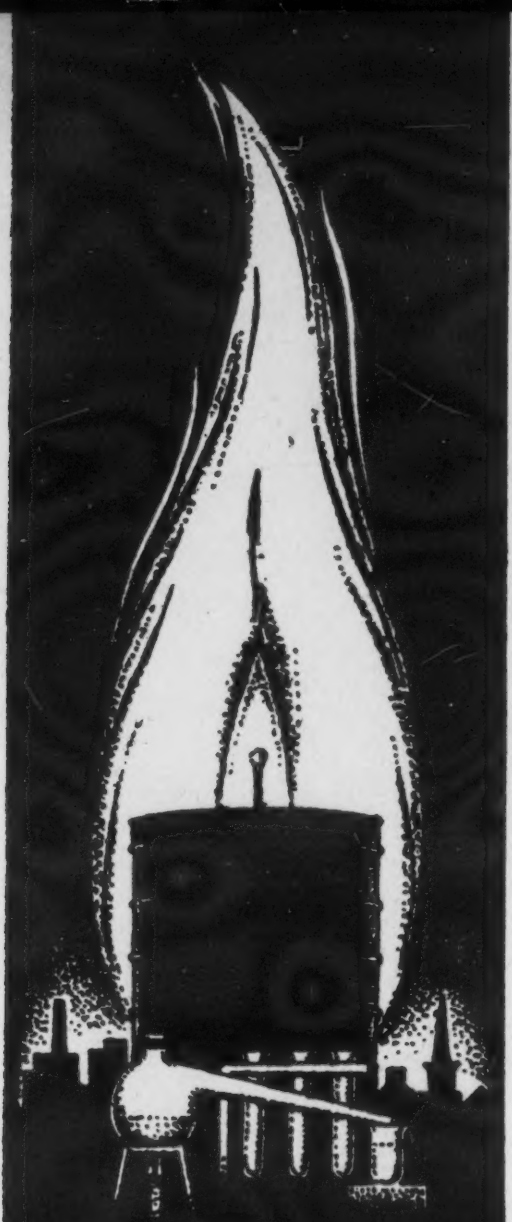

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GAS ABSTRACTS

GAS ABSTRACTS was started in 1945 by the Institute of Gas Technology to survey current technical journals, to select articles pertaining to the Gas industry, and to prepare abstracts of these articles, stressing their significance to the Gas Industry.

Selection of Articles: Each month the periodicals listed on the last page are examined and articles pertaining to the production or manufacture, distribution, transmission or storage, and utilization of natural and manufactured gas and related subjects are selected for abstracting by individual staff members of the Institute of Gas Technology. When possible the significance of the article to the Gas Industry is stressed.

Classification of Abstracts: The abstracts are grouped under twelve headings for presentation and are arranged alphabetically by subject in each group. The headings and subject matter included in each are presented below:

1. The Gas Industry will include general information and news items, statistics, business regulations and other articles of general interest.

2. Appliances – Domestic and Commercial will include burners, ranges, cooking equipment, air conditioning equipment, water heaters and other gas appliances for domestic and commercial use.

3. Combustion and Industrial Furnaces will include combustion of gaseous, liquid and solid fuels; design of industrial furnaces; control of furnace atmospheres.

4. Carbonization and Gasification will include manufacture and purification of producer gas, blue gas, carburetted water gas, synthesis gas; carbonization and gasification of coal; and gasification of oil.

5. Natural Gas and Natural Gas Condensates will include production, transmission, distribution and storage of natural gas and natural gas condensates; distribution of LP-gas mixtures; carbon black and chemicals from natural gas and natural gas condensates.

6. Petroleum and Synthetic Liquid Fuels will include production, refining-cracking, alkylation, isomerization, and utilization of petroleum and production of synthetic liquid fuels by the Fischer-Tropsch reaction and hydrogenation.

7. Analytical Methods and Tests will include new and improved methods pertaining to gas making materials, processes, products, and by-products.

8. General and Physical Chemistry will include data on chemical and physical properties of elements and inorganic compounds; new reactions; and methods for carrying out established reactions.

9. Organic Chemistry will include data on organic compounds closely related to the Gas Industry; new reactions; new methods for carrying out established reactions.

10. Chemical Engineering will include data and methods for fluid flow, heat transfer, and unit operations of distillation, evaporation, extractive drying, and filtration.

11. Process Equipment and Instrumentation will include information on new equipment for process operations and process control.

12. Materials of Construction will include new developments in refractories, heat and corrosion resistant materials, new alloys applicable to the Gas Industry, and other materials of construction.

13. New Books will include recent books pertaining to the field of gas technology.

Annual Index: Author and subject indexes will be issued at the end of the year.

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I. THE GAS INDUSTRY

CALIFORNIA NATURAL GAS RESERVES

Norman, H.S. CALIFORNIA GAS MEN STUDY MEANS OF AUGMENTING RESERVES, *Oil & Gas J.* 45, 160-161 (1946) September 21.

California reserves of natural gas are estimated to be about 11 to 12 trillion cu.ft. Oil-well gas is the chief source of supply for some sections. Recently there has been increased use of oil well gas in pressure-maintenance operations for increasing recovery of petroleum, thus severely curtailing the rate at which such gas is available for transmission and distribution. The declining supplies, rising consumption, and changing operating practices indicate the need for augmenting present reserves.

--R.S. Goodrick

NATURAL GAS ACT

Ralph, H.C. PROFIT-LIMITATION PROSPECT HAMPERS PLANS FOR LONG-HAUL GAS LINES. *Oil & Gas J.* 45, 54 (1946) September 28.

A series of amendments to the natural-gas act sharply curtailing the power of the Federal Power Commission has been recommended by counsel for the Natural-Gas Industry Committee which presented the industry's case in the recent FPC natural-gas investigation. The amendments proposed by Wesley E. Disney, general counsel for the committee and Don C. Culton, Amarillo, Texas, would legally prohibit FPC from any rate-regulation authority over production and gathering of gas. Besides clarifying the language of the act, the amendments also would forbid any restriction on end use, exclude from consideration in rate cases "a calculation value based on a natural-gas company's investment in producing properties and facilities," and define sales in interstate commerce as sales made after the interstate transportation is completed.

--Author's abstract

NATURAL GAS INDUSTRY

NATURAL GAS - GROWING COAL COMPETITOR. *Coal Age* 51, 72-77 (1946) September.

The expansion of the natural gas industry during the past fifteen years is reviewed and compared with that of coal. Cost data are given for both natural gas and coal. The following are given as weapons against natural gas competition: (1) High operating efficiency for the lowest possible cost; (2) High quality and uniformity; (3) Continuous supply; (4) Good merchandising, including development of good cooperative producer-wholesaler-retailer programs to reach consumers; (5) Development of more efficient coal-burning equipment; (6) Promotion of processes and methods providing increased cleanliness and convenience in utilization, such as heating service, smokeless community heating, gasification and liquefaction; (7) Research to improve present methods and equipment in the utilization of coal and to develop additional ones.

--R.S. Goodrick

NATURAL GAS RESERVES

De Golyer, E. NATURAL GAS RESERVES. *Gas* 22, 29-32 *(1946) September.*

The opinion is expressed that of January 1, 1946 the United States had a proved recoverable gas reserve in excess of 144 trillion cu.ft. This estimate, except for the Appalachian area and the states of Illinois, Indiana, and Michigan, includes only those fields which have reserves of 20 billion cu.ft. or more. Reserves have been calculated on a pressure basis of 16.4 psi and at 60°F. The estimate is broken down by districts with a partial breakdown by states; a more detailed breakdown is given for districts for: free gas non-associated with oil, free gas associated with oil, total free gas, estimated recoverable solution gas reserve, total free and solution gas, estimated recoverable free gas reserve; total free and solution gas, estimated recoverable free gas reserve; total recoverable solution and free gas reserve, per cent of United States reserves and estimated gross gas production during 1945.

--R.S. Goolrick.

2. APPLIANCES - DOMESTIC AND COMMERCIAL

"CP" REQUIREMENTS

NEW "CP" REQUIREMENTS FOR AUTOMATIC GAS RANGES. *Gas Age* 98, 46, 48 *(1946) September 19.*

New requirements for automatic gas ranges built to "CP" standards have been announced. These requirements, which were set up by the A.G.A. Testing Laboratories, are listed.

--R.S. Goodrick

HIGH ALTITUDE REQUIREMENTS

Conner, R.C. TESTING LABORATORIES WILL NOW APPROVE APPLIANCES FOR HIGH ALTITUDE TESTS. *Butane-Propane News* 8, 48, 51, 53 *(1946) September.*

The American Gas Association has set up new requirements effective January 1947 for domestic appliances to be operated at high altitudes. Since the lower atmospheric pressure at higher altitudes results in a greater volume of combustion products, appliances must be designed to accommodate lengthened and softened flames and the larger volume of flue gases or the normal input rating must be reduced. The new standards are for appliances using either city gases or LP-gas.

--R.S. Goodrick

WATER HEATER

BRITISH DEVELOP NEW, SMALL "SINGLE POINT" WATER HEATERS. *Gas* 22, 58, 61-62 *(1946) September.*

Two models of "single point" water heaters as developed by the British are described. One is an instantaneous heater for use with sink or wash basin, the other is a two gallon storage heater with four gallon per hour recovery capacity. Advantages of the instantaneous heaters are discussed.

--R.S. Goodrick

3. COMBUSTION AND INDUSTRIAL FURNACES

COMBUSTION

Judyakov, H.N. and Pushkin. THE PROBLEM OF FLAMELESS COMBUSTION. *Engineer's Digest* 3, 392-394 (1946) August; *Abstracted from Izvestya Akademi, Nank, USSR* 1945. No.6, 545-553.

Some elementary experiments were performed on the combustion of a hydrocarbon gas in water-jacketed packed tubes. The maximum heat release was studied as a function of particle size of the filler at a given porosity of about 50% for corundum and fire brick. Three different tube widths were used: 32mm., 48 mm., and 105 mm. The temperature of the filler was studied at various levels. No general conclusions are stated, although it is suggested that the use of such a technique may lead to ultimate combustion space savings.

--J.D. Parent

DEW POINT OF FLUE GASES

Buckley, W. SULFUR IN MANUFACTURED GAS. ITS EFFECT UPON DEW POINT OF FLUE PRODUCTS. *Am. Gas Assoc. Monthly* 28, 403-406 (1946) September.

The author correlates much of the published data on corrosion reactions and suggests the consideration of factors for further investigation on the subject. Laboratory experiments reported in the literature have shown that sulfur enters into most flue gas corrosion problems. Since the concentration of sulfur in the flue gas rather than the sulfur present in the gas before combustion determines the degree of corrosion, the author suggests that sulfur be expressed as grains per therm because the heating value of a gas generally gives a good indication of the flue gas volume that may be expected. A plot showing the necessary factors for converting sulfur concentrations from grains per 100 cubic feet to grains per therm is included. Most flue corrosion can be attributed in part to condensation. While dilution of flue products with excess air lowers the dew point, the presence of sulfur trioxide in low concentrations raises the dew point considerably. In fact, next to water vapor itself, sulfur trioxide is stated to be the most important factor in establishing the dew point temperature. Plots are given to illustrate the optimum conditions for sulfur dioxide conversion to sulfur trioxide and for the effect of sulfur concentrations on the dew point of flue gases. It is pointed out that dew point is a variable depending upon the combustion equipment employed and the conditions of its operation. Retarding the conversion of sulfur dioxide to sulfur trioxide reduces the effect of sulfur on the dew point of flue gases. This is necessary since it is shown that the first flue gas condensate may contain as much as 30-50% sulfuric acid. 26 references are given.

--H.H. Hakewill

ENAMELING FURNACE

Herr, F.A. THE WORLD'S LARGEST CONTINUOUS GAS-FIRED ENAMELING FURNACE. *Am. Gas J.* 165, 11-13, 50 (1946) September.

The furnace, a fuel muffle U-type, is 90 feet long and has a burning chamber 18'8" long, 9'3" wide and 7'6" high. The rated capacity of the furnace is 7,000 cu.ft. of natural gas an hour. The temperature in the

combustion tunnels is usually about 2500°F. and that in the enameling portion is 1500°F. The furnace has a stand-by oil burning apparatus which permits the furnace to be switched from gas to fuel oil during periods of natural gas shortage.

--R.S. Goodrick

4. CARBONIZATION AND GASIFICATION

CARBONIZATION

Illingworth, S.R. REACTIONS IN THE RETORT. *Gas Times* 48, 145-146 (1946) *August* 31.

Carbonization of coal is a time temperature chemical change which is related to the temperature gradient within the charge. The path taken by the volatile products in their escape is governed by the temperature gradient and the establishment of the plastic layer. The path of volatile products differs in the three main types of carbonization plants in use in industry. Horizontal ovens are heated on all sides hence there is no inner cool path of escape for volatile products and secondary reactions are practically complete. The tars are aromatic in character. Continuous vertical retorts have a central cool cone in the upper section of the retort which permits escape of the volatile products. The tars are of lower density than horizontal tars and considerable methane is formed. The chamber type of vertical retorts has a cooler central zone that extends parallel to the flue wall. However the coal charge is of finer size; hence the charge is less porous in nature and a greater degree of pyrolysis occurs than with continuous retorts. The tars formed are intermediate between the horizontal and continuous vertical type.

--F. Estes

CARBONIZATION - LURGI PROCESS

THE KRUPP-LURGI PLANT AT VELSEN, GERMANY. *Coke & Smokeless Fuel Age* 8, 103 (1946) *May.*

Two full-scale Krupp-Lurgi semi-coking plants have been built in Germany for the carbonization of hard bituminous coal, those at Wanne-Eickel in the Ruhr and at Velsen in the Saar. Recent information and operating results on the latter are presented in this article. The objective of the plant was to produce a high grade domestic fuel. The coal used was a medium coking coal of 14,400 gross B.t.u., 13,900 net B.t.u. per pound, ash content 3.2%. The charge to each oven was 2.5 metric tons of coal ground to pass 50% through a 1 mm. screen. The coke made was broken and graded. A gas of 850-950 B.t.u. was obtained. The volatile matter content of the coke ranged from 12 to 18 per cent.

--J.J.S. Sebastian

CARBONIZATION - LURGI PROCESS

THE LURGI PROCESS. *Coke & Smokeless Fuel Age* 8, 49 (1946) *March.*

Whereas formerly only partial information was available about the Lurgi plant in Bohlen, Germany (owned by the Sachsiche Werke, A.G.), which was the largest of its kind up to 1942, some much fuller data recently obtained are described in this article. In January 1945 five new Lurgi units were added to the plant. The complete plant of ten units, with a capacity of about 20 million cu.ft. of standard gas per day, cost 10,729,000 R.M. (Reich-marks). The new units differed from the old ones in the designs of the charging pouch, driving the grate, and the method of scraping the domes. Complete operating results are given for the new Lurgi units. The crude gas had a calorific value of 339 B.t.u., and the purified gas 455 B.t.u. The net production cost of the gas was 2.4 Rpf. (Reich-pfennig)

per cubic meter. The cost of the oxygen was about 12% of the total production cost, which does not support the opinion that the cost of the oxygen is the critical economic factor in the manufacture of Lurgi gas.

--J.J.S. Sebastian

CARBONIZATION OF PEAT

Pilo, C.W. METHOD OF CARBONIZING PEAT. *U.S. 2,406,509 (1946) August 27.*

A continuous method of carbonizing peat consists in moving the peat continuously downward through three zones. In the first, or predrying zone, hot air is passed countercurrently to the descending peat; in the second, or after-drying zone, super-heated steam at a temperature below the carbonizing temperature of peat is passed countercurrently to the peat; and in the third zone a hot gas current containing superheated steam at a temperature above the carbonizing temperature of peat is passed through the peat.

--R,S. Goodrick

GASIFICATION - COMPLETE

THE THYSSEN-GALOCSY COMPLETE GASIFICATION PROCESS. *Coke & Smokeless Fuel Age 8, 106 (1946) May.*

The Thyssen-Galocsy process, which derives from the slagging producer, is designed specifically to use hard coal or coke made from hard coal. Oxygen is used to permit continuous gasification. By dividing the oxygen supply into two channels, which enter the producer at different levels, much greater operational control is secured and the intensity of combustion is lessened, which increases the life of the refractory lining. Operating results are presented for a 40 ton per day pilot plant erected during the war at Wanne-Eickel in the Ruhr, Germany.

--J.J.S. Sebastian

GASIFICATION - COMPLETE

Pearson, B.M. GERMAN PRACTICE IN TOTAL GASIFICATION. SYSTEMS EMPLOYING INTERNAL CIRCULATION OF SUPERHEATED GASES. *Gluckauf 78, 160 (1942); Oel und Kohle 38, 685 (1942); Gas und Wasserfach 83, 1 (1940); Gas Times 45, 33-36 (1945) October 27; 45, 35-38 (1945) November 10; 45, 49-52 (1945) December 8.*

Processes which effect total gasification of coal by the employment of a circulating system of hot gases arranged to flow internally in a closed path through the coal charge are discussed in detail, with emphasis on constructional features of the plant design and operating results obtained. The fundamental problem in these processes is the transfer of about 1000 kg. cal. of heat per cu.meter of water gas produced, required by the endothermic steam-carbon reactions. With a temperature drop of about 500°C in the reaction zone, about four times the volume which is used for gasification has to be applied at the heat carrying medium, i.e. as the recycled gas. Thus, a considerable portion of the cleaned gas from the production volume has to be diverted and recycled through the heater, which may be either regenerative or recuperative, together with a corresponding amount of steam added: The objective of these processes being the production of synthesis gas, the hydrocarbons present in the circulating

gases are thermally cracked during the passage through the regenerators and the fuel bed and are converted into water gas. Thus, except for a small percentage of methane, the gas made is free from hydrocarbons. Processes operating in this manner, all of which were developed to a large scale and placed into operation, are the Pintsch-Hillebrand Gasification System, the H. Koppers Total Gasification Process and the Schmalfeldt-Wintershall System. The latter differs from the previous two processes inasmuch as it was designed for the gasification of coarsely powdered fuel, which is obtained in the system itself by the disintegrating effect of the sudden impingement of superheated gases on the moist friable coal. The resultant small fuel particles are then gasified in flow suspension in the stream of internally circulating superheated gases and steam. Operating results are given for the Pintsch-Hillebrand and H. Koppers processes, but not for the Wintershall-Schmalfeldt process.

--J.J.S. Sebastian

GASIFICATION - COMPLETE

Pearson, B.M. GERMAN PRACTICE IN TOTAL GASIFICATION SYSTEMS OPERATED BY EXTERNAL HEATING OF GASIFICATION CHAMBER. *Gas und Wasserfach* 84, 509 (1941); *Gas Times* 45, 46-48 (1945) December 22; 46, 41-44 (1946) January 5; 46, 35-40 (1946) January 19.

In the continuous gasification systems falling in this grouping, the heat necessary for the water gas reactions is transferred indirectly through the walls of the gasification chamber. Some of the earlier processes which did not advance beyond patent specification, or whose experimental installations were abandoned, are the Heller process, the Herzberg process, the Lichtenberger and Kaiser process which used a molten salt bath for heat transfer, etc. The Bubiag-Didier system for the production of water gas in an externally heated vertical chamber, the lower portion of which is continuously charged with coke made in a superimposed carbonization zone, proved to be very efficient and has been in operation for several years. There is a flue space between each two chambers and a recuperator serves for the preheating of producer gas which is burned with air in the flues. The combustion products heat the recuperator and the coal charged. A main feature of the Bubiag-Didier process is unusual flexibility in the gasification of low grade fuels. A variety of gases, ranging in heating value from 280 to 480 B.t.u., and in methane content from 0.5 to 25% may be produced. Thus with minor modifications, such as the location of the off-take pipe and the temperature maintained in the gasification chamber, the same equipment can be used for the production of synthesis gas and for the making of town gas. Operating data obtained in various plants are given, and the yields of gas, coke, tar, benzol, etc. are discussed in detail.---- A second gasification system, operated on the principle of heat transfer through the walls of heat resistant alloy steel tubes, was developed on an experimental scale in the Reiche Zeche plant, although it has not yet been operated on a large scale commercially. A series of about 7 1/2 wide "Sichromal" tubes, through which the fuel charge passes downward, are externally heated by the hot combustion products of producer gas burned in an adjacent combustion chamber. Some operating results are given from the pilot plant operation, but it is premature to draw conclusions regarding a commercial sized plant.

--J.J.S. Sebastian

4. CARBONIZATION AND GASIFICATION

GASIFICATION OF LIGNITE

Parry, V.F., Gernes, D.C., Goodman, J.B., Wagner, E.O., Koth, A.W., Patty, W.L. and Yeager, E.C. GASIFICATION OF LIGNITE AND SUBBITUMINOUS COAL. *U.S. Bureau of Mines R.I. 3901, 1-59 (1946) June.*

This report summarizes the results of the investigations on lignite gasification made by the Bureau of Mines during 1944. The purpose of these investigations was to obtain a high-hydrogen reducing gas from lignite in order to realize the broader objective of utilizing the large deposits of lignite in North Dakota with the low grade iron ore of Minnesota. The report includes investigation on the gasification of lignite in laboratory retorts and in Glover-West retorts as well as the gasification of lignite char briquets in a water-gas machine and the gasification of subbituminous coal and lignite in a pilot plant Parry retort. The last named method employs an annular alloy retort externally heated by a special combustion chamber with a recuperator.

--F. Estes

OXYGEN-STEAM GASIFICATION

Mitchell, R.F. OXYGEN-STEAM PRODUCER BLAST. *Canadian Chemistry & Process Industries 30, 34-42 (1946) August.*

A commercial plant built to use an oxygen-enriched producer blast for ammonia synthesis is described. Conditions at the plant have occasionally made it feasible to run straight oxygen-steam blasts without air, and a number of commercial scale runs are described in detail. Advantages in the use of an air-free oxygen blast are cited; these include the lower space velocity, hence the longer contact time of the gases for a given gasification rate. Deeper fuel beds may be used, and dusting losses are reduced. The transfer of heat from the oxidation to the reduction zone takes place under controlled conditions, and sensible heat losses due to the nitrogen are eliminated. The oxygen-steam blast appears to be commercially feasible, and capital costs are no greater than with the conventional air-steam systems. Its development in this country will be dependent on cheap methods of oxygen generation and large supplies of inexpensive fuels.

--S. Katz

PURIFICATION BY HYPERSORPTION

Berg, C. HYPERSORPTION PROCESS FOR SEPARATION OF LIGHT GASES. *Trans. Am. Inst. Chem. Eng. 42, 665-680 (1946) August 25.*

The process employs an adsorbent for preferentially removing the heavier constituents of a mixture. For the mixtures studied activated carbon proved to be much more effective than an absorbing oil. Fundamental data on heat transfer, allowable gas velocities, adsorbent attrition and other factors were studied. Process details, mechanical details and results obtained with some mixtures are reported. For example, with a feed 52.2% H_2, 43.5% CH_4, 2.7% C_2H_6 and 1.6% C_3H_8 the make was 91.0% CH_4, 5.6% C_2H_6 and 3.4% C_3H_8 while the discharge was 100.0% H_2. The unit has essentially two heat transfer sections consisting of shell and tube exhangers, separated by adsorption and rectifying sections with trays. Fresh or regenerated granular carbon comes from a hopper at the top into a cooling section.

It then flows down through the adsorption section; the gaseous feed flows countercurrently up through the bed and out below the cooler. The carbon continues to flow downward through the next section which is for rectification; here it meets a stream of heavier reflux from the stripper. The solids next flow through the stripping section which is heated with steam. They finally flow out through a seal leg into an air stream which lifts them up through a final stripper into an overflow which leads to the hopper. There are no turns in this line so as to avoid attrition. An extremely clever flow control mechanism is described. The make gas is removed just above the stripper and a side cut can be taken further up in the rectifying section. This process deserves considerable attention in purification problems. It is not unlike the Thermofor process in some of its aspects.

--J.D. Parent

SEMI-AUTOMATIC GAS MAKER

Clapp, L. SEMI-AUTOMATIC GAS MAKING CONTROL. *Gas* 22, 65-6 *(1946) September.*

The San Diego Gas and Electric Co. has designed and built a semi-automatic gas-maker control which times the gas-making process and opens and closes the necessary valves. A description of the equipment is included. One application of the automatic control is the training of new employees in the manufacture of gas.

--R.S. Goodrick

WATER GAS SETS

Jenkins, B.P. INCREASING WATER GAS SET CAPACITY. *Gas Age* 98, 21-26, 60 *(1946) September 5.*

This paper deals with generator air supply, a subject which, according to the author, has not generally received the degree of attention that its importance justifies. Poor metering in the plant, which is the rule rather than the exception, does not permit the installation of proper blowers. The author states that it would be advisable to visit plants having new blower installations and to study the problem using the manufacturer's test data instead of data from plant meter installations. Several plant cases are discussed, showing how various operating difficulties were overcome. Charts, reproduced from proposals and guarantees received in 1946 for large blowers from several manufacturers, are presented. These are pressure-volume curves only, as this paper is primarily a discussion of this phase only. The horsepower-steam consumption curves are also important and must be considered when choosing equipment. The curves are discussed in detail to indicate the effect of operating characteristics on the generator blasting conditions.

--J.J. First

5. NATURAL GAS AND NATURAL GAS CONDENSATES

COMPRESSOR STATIONS

Foster, A.L. AUTOMATIC COMPRESSOR STATIONS SOLVE UNITED'S FIELD SUPPLY PROBLEM. *Oil & Gas J.* 45, 186-189 *(1946) September 21.*

One man operates and services three automatic compressor stations for United Gas Pipe Line Co. in the Texas Panhandle, including eight self-contained, semiportable units handling gas from the field where pressures are dwindling to the main station. Details of the design and operation of these units are given in this article.

--Author's Abstract

DISTRIBUTION

Buddrus, E. MEETING INCREASED DEMAND FOR NATURAL GAS WITH PRESENT PIPE LINE FACILITIES. *Oil & Gas J.* 45, 180-181 *(1946) September 21.*

To meet increased demand for natural gas with present pipe-line facilities operating at an already high load factor and with the compressor stations at their maximum, two possible methods of attack are enhancing delivery capacity and increasing storage capacity. The former can be accomplished in a number of ways, e.g. by increasing heating value of the gas by addition of hydrocarbons or removal of inerts, or extracting water vapor, thereby preventing the formation of hydrates. Increase in storage capacity can be accomplished by one of the following methods; underground storage, storage of liquefied natural gas, pipeline storage, liquefied petroleum gas storage, high pressure gas holders, and low pressure gas holders.

--R.S. Goodrick

DISTRIBUTION

Stephens, F.M. THE EFFECTS AND CORRECTIONS OF GAS-PULSATION PROBLEMS. *Oil & Gas J.* 45, 78-79, 102-103 *(1946) September 14, Gas Age* 98, 31-32, 56, 58 *(1946) September 19.*

Pulsation in gas flow has the objectional effects of vibration in compressors and pipes, causing inaccurate orifice metering, resulting in errors in excess of 20 per cent in some instances, fluctuations in pressure-gage readings and loss in horsepower. Pipe-line vibration has been reduced in many cases by changing the arrangement of the pipes and by tieing down structurally the points of excessive displacements. Another method for decreasing the magnitude of piping vibration is the installation of mechanical vibrational dampeners at certain strategic spots in the piping system. These dampeners usually consist of combinations of weights and springs, weights and rubbers, or just springs. To reduce errors in metering, pinching valves may be installed in the meter lead line or volume chambers or orifice plates installed ahead of meter runs. The pulsation dampener designed on the fitter principle, has been universally used to correct pulsation problems and consequently their secondary effects by converting the pulsative flow into a steady flow. With the elimination of most of the pulsation, most of the vibration due to pulsative flow is eliminated.

--R.S. Goodrick

5. NATURAL GAS AND NATURAL GAS CONDENSATES

DISTRIBUTION - PIPE-LINES

ECONOMICS OF GAS LINES. *Oil & Gas J.* 45, 176-177 *(1946) September 21.*

Three economic principles involved in gas pipe-line construction and operation are: (1) For any given diameter line, delivery cost per unit increases about in direct ratio with the increase in length. (2) The volume capacity of gas lines increases more rapidly with increased diameter than the increased cost per mile. Therefore the larger the line the lower the unit cost at capacity volume. (3) Delivery cost per unit varies with the percentage change in load factor. The per cent variation in unit cost is about the same for any given load factor for any given length of line, regardless of diameter. The major physical and economic problem facing the gas pipe-line industry today is one of economically connecting the great reserves of gas in the Southwest with the industrial markets of the north and east. The construction of long lines from the southwest is encouraged by the discovery of large dry gas fields and secondary gas conservation which has resulted from petroleum engineering technology.

--R.S. Goodrick

DISTRIBUTION - PIPE LINES

Heltzel, W.G. TRENDS IN PIPE-LINE PRACTICES. *Oil & Gas J.* 45, 182-183, 281 *(1946) September 21.*

In this article the author discusses the future growth of product-distribution lines, possibilities of pipe lines for transmitting coal gas, problems of pipe lines serving new oil fields, and advantages of larger diameter pipe lines. A subsequent article will present his views regarding pipe-wall thickness, higher pressures, pumping equipment, and diesel engines.

--Editor's abstract

DISTRIBUTION - PIPE LINES

Heltzel, W.G. TRENDS IN PIPE-LINE PRACTICES. *Oil & Gas J.* 45, 81-84 *(1946) September 28.*

Pipe-wall thickness, higher operating pressures, pumping equipment, and diesel engines are discussed.

--Author's abstract

METER TESTING

Bean, H.S., Benesh, M.E. and Whitting, F.C. TESTING LARGE CAPACITY GAS METERS. A METHOD THAT MAY BE USED IN THE FIELD. *Gas* 22, 33-40 *(1946) September.*

A method that can be used in the field for testing large capacity gas meters is described. The method is composed of three parts: (1) determining the meter's displacement; (2) determining the rate of flow through clearance at different pressure drops; and (3) determining the pressure drops across the meter for various flow rates. Equipment and procedure details are given. The work was done at Peoples Gas Light & Coke Co. in conjunction with the National Bureau of Standards.

--J.D. Parent

5. NATURAL GAS AND NATURAL GAS CONDENSATES

NATURAL GAS SUBSTITUTES

Lewis, W.K. REPLACEABILITY OF NATURAL GAS. *Gas Age* 98, 29-30, 62, 64 (1946) *September* 5.

The purpose of this paper is to discuss the significance of various processes for generating gas and oil from coal on the over-all fuel picture of the United States. Both natural gas and oil are completely replaceable by-products made from coal. As a fuel, natural gas has two advantages, in addition to its low cost, over competitive gases; higher heating value and the compounds of which it is composed are more stable chemically, thus producing less deposits and gum in lines, meters, burners, etc. For use as a source of chemical raw materials, natural gas has the disadvantage that it must first be converted into a mixture of carbon oxides and hydrogen. These products are made on a much greater scale today from coal than natural gas. Oil has been produced commercially in Germany by two processes, the Bergius and the Fischer-Tropsch. Oil is cheaply and easily converted into gas and oil gas is used commercially in regions where neither natural gas nor coal is readily available. Large scale plant is presently being built for the manufacture of oil from natural gas by a modified Fischer-Tropsch process. Processes are now under way which would produce from coal (1) a high heating value gas and (2) liquid hydrocarbon oils for motor fuels. In conclusion, solid, liquid, and gaseous fuels are interchangeable into each other by processes which are already on an industrial scale or which are fully developed. The only limitations on interchangeability are economics. Indications are that in a few years the cost of synthetic gas may be easily brought below the cost of natural gas.

--R.S. Goodrick

ORIFICE PLATES INSTALLATION

Gess, L. and Irwin, R.D. ORIFICE PLATES AND DIFFERENTIAL CONNECTIONS. *Gas* 22, 48-49 (1946) *September*.

This is a short but clear article on how to design and install orifice plates and how to locate pressure taps.

--J.D. Parent

TRANSMISSION

Bridge, A.F. TEXAS GAS FOR CALIFORNIA. *Oil & Gas J.* 45, 204-215 (1946) *September 21*.

Engineering factors and plan details for the Texas-California natural gas line are reported in this article. Much interest in the transmission system centers on the unprecedented use of 30 in. pipe on the California end of the system and provisions made for using the larger diameter section as a storage zone. The paper explains procedure in fabricating the pipe and the engineering design of pressure-limiting stations.

--Author's Abstract

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

HYDROFORMING

Hill, L.R., Vincent, G.A. and Everett, E.F. HYDROFORMING FOR PRODUCTION OF HIGH OCTANE MOTOR FUEL. *Trans. Am. Inst. Chem. Eng.* 42, 611-637 (1946) August 25.

The hydroforming process converts low-octane naphthas into stable, high octane motor gasoline by means of dehydrogenation and cyclization. These reactions are promoted by a molybdena-on-alumina catalyst at temperatures of 900-1000°F. and pressures of 150-300 lb./sq.in.gage, with a high partial pressure of hydrogen in the reaction zone. Hydrogen is one of the products of the reaction, which makes it possible to maintain a high hydrogen concentration in a gas stream which is recycled to the reactor along with vaporized feed. Hydroforming is carried out in a unit having four reactors filled with catalyst, two of which are always in series on reaction and two in different stages of regeneration. The reactors are switched from reaction through several regeneration steps and back to reaction in cycles of 8 to 16 hr. duration by an electric cycle-controller. Regeneration is necessary because a small deposit of carbon and a partial reduction of the metal in the catalyst combine over a period of hours to reduce the activity of the catalyst. When charging naphthas with a high sulfur content, a gradual sulfiding of the catalyst also contributes to the loss of activity. The carbon is burned and the catalyst reoxidized by combustion in a stream of air greatly diluted by cooled and recirculated flue gas. The reaction products are recovered and fractionated in a four-tower fractionating system which has as its products: (1) a hydrogen-containing gas substantially free of hydrocarbons heavier than propane, (2) a highly aromatic "polymer" boiling above 400°F., and (3) a depropanized, 400°F. end point gasoline.

--Author's Abstract

ISOMERIZATION

Armistead, G., Jr. ISOMERIZATION OF NORMALLY LIQUID HYDROCARBONS. *Oil & Gas J.* 45, 93-97 (1946) September 28.

Isomate process first demonstrated the practicability of isomerizing low-grade naphthas for aviation or motor fuel blending during the recent war. Hydrogen is introduced to minimize cracking by anhydrous $AlCl_3$ during the reaction of isomerization. High reaction pressures in the presence of hydrogen make for longer catalyst life by hydrogenating the catalyst complex and slowing the dehydrogenation reaction thereon. Recycling gives best yields and highest-octane-number product. The $AlCl_3$ content of the catalyst complex should be held below about 70 per cent, to prevent $AlCl_3$ from dissolving appreciably in the charge. Up to 93 per cent of 91-octane-number neohexane is formed at 4:1 recycle ratio.

--Author's Abstract

METHANE AS MOTOR FUEL

Bridgwater, R.M. LIQUID METHANE AS A MOTOR FUEL. *Petroleum* 9, 194 (1946) *August.*

The possibility of using methane as a motor fuel is of interest to the petroleum industry for two reasons. Firstly, with the necessity for

reducing our imports to a minimum, Britain must make as much use as possible of materials which are efficient substitutes for petroleum products. Secondly, in countries such as the U.S.A. which are abundantly endowed with petroleum, there is usually a large quantity of natural gas available. If this gas, which consists largely of methane, is used to the best advantage, petroleum supplies will last longer. The supplies which might be made use of without affecting other existing processes are: natural gas, mines gas, sewage gas, and surplus coke oven gas. Potential sources of methane are as a by-product in the refining of petroleum, the hydrogenation of coal and oil, and the Fischer-Tropsch and related syntheses. The properties of methane make it particularly suitable for use in internal combustion engines. It can be transported in various ways, but the most advantageous method is in liquid form. On a weight basis, methane has a higher calorific value than any other substance except hydrogen. One pound of methane has a calorific value 14% greater than the same weight of petrol. It should be pointed out, however, that, since the density of liquid methane is 0.43 compared with about 0.74 for petrol, its calorific value on a volume basis is 34% less than that of petrol. Methane has excellent anti-knock properties. Additional advantages in the utilisation of methane for internal-combustion engines are that there is a smaller percentage of carbon monoxide in the exhaust gases than in the case of petrol, and that starting from the cold is easier. The latter point is, of course, true of all gaseous fuels.

--Excerpt from article

MOTOR FUEL MANUFACTURE

Foster, A.L. NEW COKING UNIT ADDS VERSATILITY, INCREASES YIELDS OF PURE'S REFINERY. *Oil & Gas J.* 45, 74-79 *(1946) September* 7.

By rearranging the flow so that all crude from three combination units is reduced to 30 per cent bottoms which is fed to a new delayed coking unit, Pure Oil Co. is enabled to raise its motor-fuel production from 52.5 to 59.4 per cent of the crude charge. Heavy or residual fuel-oil production is reduced from 27.6 to 17.2 per cent while other main streams are held to the same yields. Octane rating average, for the greater gasoline yield, is raised about four A.S.T.M. numbers.

CORROSION

Prange, F.A. THE AGENTS, BASIC CAUSES, CONTROL AND PREVENTION OF CORROSION, *Oil & Gas J.* 45, 88, 91, 93 (1946) September 7.

The author discusses the general theory of corrosion, the corrosive agents in the oil industry, the types of corrosion and methods of prevention. The primary corrosive agents for steel are oxygen from the air, hydrogen sulfide, carbon dioxide and organic acids, the acidity resulting from the hydrolysis of calcium and magnesium salts. The corrosive action of hydrogen sulfide and carbon dioxide at higher pressures is much greater. The corrosion may be due to direct chemical attack or electrolytic action. The presence of chlorides in the oil, higher temperatures, and increased liquid flow velocity accelerate corrosion.

--R.S. Goodrick

HYDROCARBONS - PURIFICATION

Glasgow, A.R., Jr., Murphy, E.T., Willingham, C.B. and Rossini, F.D. PURIFICATION, PURITY, AND FREEZING POINTS OF 31 HYDROCARBONS OF THE API-NBS SERIES. *J. Research Natl. Bureau of Standards* 37, 141-145 *(1946) August.*

This report describes the purification and determination of freezing points and purity of 31 hydrocarbons of the API-NBS series, including 2 pentanes, 5 hexanes, 2 heptanes, 1 octane, 3 alkylcyclopentanes, 3 alkylcyclohexanes, and 15 alkylbenzens.

--Author's Abstract

SYNTHINE PROCESS

Lane, J.C. and Weil, B.H. THE SYNTHINE PROCESS. II. THE CATALYTIC SYNTHESIS, INCLUDING CATALYSTS AND REACTION MECHANISMS. *Petroleum Refiner* 25, 423-434 *(1946) September.*

Using cobalt or nickel catalysts the predominate reaction of the synthesis is determined largely by the $CO-H_2$ ratio, although both of the following reactions take place to some extent.

$$nCO + (2n + 1)\ H_2 \longrightarrow C_nH_{2n+2} + nH_2O$$

$$nCO + 2nH_2 \longrightarrow C_nH_{2n} + nH_2O$$

Over iron catalysts the reaction becomes $2nCO + nH_2 \longrightarrow C_nH_{2n} + nCO_2$. Commercial catalyst used in Germany is $Co-ThO_2$ - MgO- kieselguhr (100:5:8:180-220). Complex catalysts containing nickel, iron or ruthenium have also been studied. The reaction is exothermic and takes place in a fairly narrow temperature range. Other variables which affect the product are pressure rate of through-put and H-CO ratio. The mechanism of the reaction is not completely understood but it is generally agreed that the first step is the formation of a metallic carbide. The iso-synthesis and aromatization reactions are briefly described.

--F. Estes

10. CHEMICAL ENGINEERING

FLUID CATALYST TECHNIQUE

Daniels, L.S. FLUID-CATALYST TECHNIQUE. *Petroleum Refiner* 25, 109-116 (1946) *September.*

Some operating data, equipment sizes, mechanical details, and pressure drop calculations are given.

—J.D. Parent

HEAT TRANSFER

Chukanov, Z.F. HYDRODYNAMIC THEORY OF HEAT EXCHANGE AND DIFFUSION IN TURBULENT GAS FLOW IN PIPES. *Engineer's Digest* 3, 383-384 (1946) *August; Abstracted from Reports of the Academy of Sciences of USSR* 43, *No.7*, 277-82 (1944).

The author re-examines the mechanism of turbulent flow and decides that even along the wall the flow is not of the ordinary laminar type due to pulsations accompanying eddies. The assumption is made that practically all of the resistance to flow is due to the turbulent core and that the loss in head is dependent on the loss in kinetic energy which attends the penetration of part of the core into the pseudo-laminar layer along the wall. The transfer of heat is assumed to be similar. An expression is derived which gives results almost identical with those of the empirical Dittus-Boelter equation.

--J.D. Parent

REAL GASES

Su, Gouq-Jen and Chang, Chien-Hou. GENERALIZED EQUATION OF STATE FOR REAL GASES. *Ind. Eng. Chem.* 38, 800-802, 802-803 (1946) *August;* Su, Gouq-Jen. MODIFIED LAW OF CORRESPONDING STATES FOR REAL GASES. *Ibid*, 803-6.

Note: Following is a discussion of the above articles which were abstracted in *Gas Abstracts* 2, *No.9*, 200.

The ideal gas law can be put in the form $P_R V_R = T_R \frac{RT_c}{P_c V_c}$ where P_R is the reduced pressure, T_R is the reduced temperature and V_R is the reduced molar volume. Since $\frac{RT_c}{P_c V_c}$ varies from 3 to 5 for most gases and since measurements of V_c are difficult to make, it is proposed that $V_{I,R}$ rather than V_R be correlated in terms of P_R and T_R; $V_{I,R}$ is the ideal molar volume. The ideal gas law can be put in the form $P_R V_{I,R} = T_R$. For non-ideal gases the authors tried certain empirical forms. In the first paper the reduced van der Waals equation, $P_R = \frac{8T_R}{3V_R - 1} - \frac{3}{V_R^2}$, is rewritten as $P_R = \frac{8T_R}{8V_{I,R} - 1} - \frac{0.422}{V_{I,R}^2}$; a maximum average deviation of 3% is claimed for the new form when applied to seventeen gases at conditions up to near the critical density. In the second paper the reduced Beattie-Bridgeman equation is changed somewhat to read as follows:

$P_R = \frac{T_R}{V_{I,R}^2}\left[V_{I,R} + 0.160\left(1 + \frac{0.190}{V_{I,R}}\right)\right] - \frac{0.472}{V_{I,R}^2}$. An average maximum

deviation of 2% is found for seventeen gases for densities up to twice the value at the critical point. In the third paper the assumption is made that the form $P_R V_{I,R} = uT_R$ applies and that u depends only on P_R and T_R. A correlation good within 1% in the range investigated is claimed.

—J.D. Parent

VAPOR-LIQUID EQUILIBRIA

Puck, T.T. and Wise, H. DETERMINATION OF VAPOR PRESSURE OF LIQUIDS. STUDIES IN VAPOR-LIQUID EQUILIBRIA. *J. Phys. Chem.* 50, 329-338 *(1946) July.*

A new dynamic method for the measurement of saturated vapor densities of liquid is described. The liquid under examination is vaporized at a constant known rate and the vapor is allowed to impinge together with an inert carrier gas on a polished metallic target whose temperature is controlled accurately. The vapor concentration at which a film just forms on the target is the saturation value for the substance at the temperature of the target. Values for a number of liquids are compared with those reported in the literature. Agreement is usually excellent.

—S. Katz

PERIODICALS ABSTRACTED FOR GAS ABSTRACTS

AMERICAN GAS ASSOCIATION MONTHLY

AMERICAN GAS JOURNAL

AMERICAN PETROLEUM INSTITUTE QUARTERLY

AMERICAN SOCIETY FOR TESTING MATERIALS BULLETIN

AMERICAN SCIENTIST

BERICHTE DER DEUTSCHEN CHEMISCHEN GESELLSCHAFT

BITUMINOUS COAL RESEARCH

BLAST FURNACE AND STEEL PLANT

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BRITISH COAL UTILISATION RESEARCH ASSOCIATION MONTHLY BULLETIN

BULLETIN AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

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CALIFORNIA OIL WORLD

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CHEMICAL ABSTRACTS

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CHEMICAL AND METALLURGICAL ENGINEERING

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GREAT BRITAIN FUEL RESEARCH INTELLIGENCE STATION ABSTRACTS

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INSTITUTION OF GAS ENGINEERS: BULLETINS, COMMUNICATIONS AND TRANSACTIONS

INSTRUMENTS

IRON AGE

JOURNAL OF THE AMERICAN SOCIETY

JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

JOURNAL OF APPLIED MECHANICS

JOURNAL OF APPLIED PHYSICS

JOURNAL OF CHEMICAL EDUCATION

JOURNAL OF CHEMICAL PHYSICS

JOURNAL OF CHEMICAL SOCIETY (LONDON)

JOURNAL OF THE INSTITUTE OF FUEL

JOURNAL OF THE INSTITUTE OF PETROLEUM

JOURNAL OF ORGANIC CHEMISTRY

JOURNAL OF PHYSICAL CHEMISTRY

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OFFICIAL GAZETTE OF THE U.S. PATENT OFFICE

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